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NONRULE POLICY DOCUMENT

Indiana Department of Environmental Management
Office of Land Quality
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Title: Drilling Procedures and Monitoring Well Construction Guidelines
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Brief Description of Subject Matter: The purpose of this document is to assist drillers, geologists and contractors who are conducting or evaluating subsurface investigations to be submitted to programs in the IDEM OLQ Remediation Services Branch. This guidance is applicable only for sites overseen by the OLQ Remediation Branch, and not to other IDEM Programs. In particular, it is not expected that this guidance will apply at RCRA permitting sites. These procedures for borings and monitoring well installations have been compiled from State Statutes and Rules IC 13-30, IC 25-39, 312 IAC 12, 312 IAC 13, and 329 IAC 9; combined with some clarifications and specifics pertinent to the Remediation Services Branch programs. Program specific requirements may also be applicable, and the respective IDEM program should be consulted before drilling. These guidelines are not requirements (unless covered by the State Rules above), but following this guidance should ensure prompt acceptance of borings and wells by staff during IDEM evaluation. Other procedures may be acceptable if they do not violate existing State rules, but deviations will need to be evaluated on a case by case basis. The procedures in this guidance may be applied to sites of all sizes, but variations are more likely to be appropriate at larger and more complex sites.
Citations Affected: IC 25-39, IC 13-30, 312 IAC 12, 312 IAC 13 and 329 IAC 9

This nonrule policy document is intended solely as guidance and does not have the effect of law or represent formal Indiana Department of Environmental Management (IDEM) decisions or final actions. This nonrule policy document shall be used in conjunction with applicable laws. It does not replace applicable laws, and if it conflicts with these laws, the laws shall prevail. This nonrule policy document may be put into effect by IDEM thirty days after presentation to the appropriate board and after it is made available to public inspection and comment, pursuant to IC 13-14-1-11.5. If the nonrule policy is presented to more than one board, it will be effective thirty days after presentation to the last. IDEM will submit the policy to the Indiana Register for publication. Revisions to the policy will follow the same procedure of presentation to the board and publication.

Drilling Procedures and Monitoring Well Construction Guidelines

Part 1. INSTALLATION OF BORINGS AND MONITORING WELLS

(I) DRILLING METHODS

(A) The principles and procedures recommended by the OLQ Science Services Branch for drilling boreholes and installing monitoring wells should ensure:
(1) Subsurface materials are not adversely affected.
(2) Ground water or aquifers are not contaminated or cross-contaminated.
(3) Continuous and representative formation samples can be collected.
(4) Adequate placement of the filter pack and annular sealants.

(B) Drill fluids other than water are to be avoided. However, if they are unavoidable, the consultant geologist for the project should provide OLQ with a rationale for use and an evaluation of the potential impact of drill fluids on the physical and chemical characteristics of the subsurface and groundwater.

(C) To prevent contamination or cross-contamination, all equipment that may encounter contaminated formation materials must be decontaminated prior to drilling each new borehole, and sampling equipment must be decontaminated between sampling intervals (312 IAC 13-8-3). Decontamination fluids must be captured, containerized, and properly disposed of, as described in Sections XII and XIII.

(D) Common drilling methods include:
(1) Hand Augers: This method is commonly used for borings less than fifteen feet deep, or explorations near utility lines.
(2) Solid-Flight Augers: This method should not be used since the auger is solid, and proper soil sampling cannot be conducted. Soil sampling from auger cuttings is not acceptable, because of the churning of the material.
(3) Hollow Stem Augers: Similar to Solid-Flight Augers, however, the hollow center portion allows for the collection of formation samples using sampling devices. The hollow center also allows for the installation of well materials without the possibility of borehole collapse. Augers can not drill into bedrock, but can be used in most unconsolidated materials.
(4) Air Rotary: Used mostly for drilling bedrock wells. Given the large volume of air introduced to the hole, it is possible that biodegradation, oxygenation, or vaporization could occur as a result of the drilling. Sampling of wells installed using this method should be postponed until this effect has dissipated.
(5) Air Rotary with Casing Driver: With the addition of a casing driver, air rotary methods can be used in unconsolidated materials.
(6) Direct Push: OLQ encourages the use of this economical and fast method for drilling soil borings, to obtain cores and groundwater grab samples for exploration and characterization, or other one-time sampling events. Monitoring wells set by direct push methods can provide good service in sandy soils. However, the EPA reports high turbidity and trouble in getting enough sample volume from direct push wells in some geologic settings. The EPA states that "*DPT (Direct Push Technology) will not be appropriate for all situations*." "*Use of DPT may be limited in lower yield formations. Conventional wells with larger diameters may be required to minimize the affect (sic) of lower yield formations.*" (EPA 540/R-04/005) The DNR rules on monitoring wells state "*The composition, wall thickness and nominal diameter shall be sufficient to allow the well to be used for its intended purpose.* (312 IAC 13-8-3) If the monitoring well data is not acceptable, the well is not suitable for its purpose and must be replaced. To guard against unprofitable expenditures, the OLQ project manager and geologist should be consulted before wells are installed at a site, to determine the type of wells best suited for the site geologic conditions.
(7) Rotasonic: This method is particularly well suited for well installation without cross-contamination in thick unconsolidated deposits and heaving sands. It also provides a higher percent core recovery than hollow stem augers, but is expensive for normal site investigations.
(8) Cable Tool Drilling
(9) Dual-wall Reverse Circulation
(10) Fluid Rotary (also known as Mud or Water Rotary)

The last three methods presented are seldom used to drill monitoring wells, but may be used in some applications. The person responsible for installing the monitoring well should consult with OLQ if one of these methods is being considered. For a more in-depth description of most of the above methods, consult the USEPA Document "Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells" EPA/600/4-89/034.

(II) BOREHOLES

(A) Boreholes, used to sample soils and for one-time-only groundwater grab samples, may be any diameter as long as quality samples can be obtained. However, small diameter cores may not yield sufficient material for field descriptions and laboratory analyses.
(B) Boreholes for monitoring wells should be drilled by methods which will remove the formation material for core logging. Methods which compact or push most of the formation materials to the side of the boring should not be used due to the compaction and alteration of the formation.
(C) "*A monitoring well installed by the rotary or auger drilling method shall have a borehole with a diameter at least two (2) inches greater than the nominal diameter of the casing.*"(312 IAC 13-8-3)
(D)Direct push borings must be large enough for their intended purpose(s), and to allow for proper abandonment of the borehole afterwards.

Please refer to State Rule 312 IAC 13-8-3 for additional information.

(III) SAMPLING AND ANALYSES

(A) Continuous downhole samples of the unconsolidated and consolidated materials should be collected in all borings, unless otherwise agreed to by the OLQ geologist or project manager. Monitoring wells installed within five feet of a previously made boring do not have to be sampled if adequate samples and a log from the nearby boring were obtained. For well clusters, continuous samples should be collected from the surface to the base of the deepest well. Samples for description or laboratory analyses should be as undisturbed as practicable, so auger cuttings are not acceptable.
(B) If direct push methods are used for sampling in contaminated areas, well casings or double walled sampling tubes should be used.
(C) For borings installed to delineate the nature and extent of contamination, all soil intervals should be field screened (if that is possible for the contaminant of concern) using appropriate, properly calibrated instrumentation suitable for detecting the contaminant present. Most current field screening instruments are useful for qualitative measurements but are not sufficiently accurate to define the extent of contamination, which should be done using laboratory analyses. At a minimum, samples for laboratory analysis should be taken from the interval exhibiting the highest field screening results or directly above the water table if all readings are low. Other locations may be appropriate where supported by specific reasons identified by the site geologist.
(D) For borings installed to delineate the extent of contamination, vertical sampling should continue until the contamination is no longer encountered, not just to a pre-determined depth or the water table. Confirmatory laboratory samples should be taken at the base of each boring, or below the contamination, to define the vertical extent of contamination.
(E) Many direct sensing devices are capable of being mounted on a direct-push system. These systems may provide useful data and an efficient delineation of contaminants. The use of such systems, which should include at least three (3) ground-truth or calibration borings, should be approved by the OLQ site geologist on a site-specific basis.
(F) Monitoring wells should not be used for applications of remediation products.
(G) Reports and work plans submitted to OLQ should specify all procedures regarding sampling and testing.

Please refer to State Rules 329 IAC 9-5-5.1, 312 IAC 13-2-6 and 312 IAC 13-8-3 for additional information.

(IV) CASING MATERIALS

(A) "*A monitoring well shall be equipped with casing. The composition, wall thickness and nominal diameter of the casing shall be sufficient to allow the well to be used for its intended purpose.*" (312 IAC 13-8-3)

(B) "*Monitoring well casing shall be new first class material that meets the American Society of Testing Materials (ASTM) standards ASTM A-120 (1984) or ASTM A-53 (1987) or the American Petroleum Institute (API) standards API-5A or API-5L (1987). Thermoplastic pipe shall comply with ASTM F- 480 (1981). Well casing shall be as follows:*

(1) *Clean and free of rust, grease, oil, or contaminants and composed of materials that will have minimal impact on the quality of a water sample.*

(2) *Centered in the borehole and free of obstructions so monitoring devices can be lowered into the well*." (312 IAC 13-8-3)

The monitoring well casing should also be:

(3) Composed of materials which will not be degraded or react with the contaminants of concern.

(4) Sealed with commercial O-rings and mechanically fastened, or threaded together without the use of glues, oils, or joint compound.

Please refer to State Rules 312 IAC 12-3-1 and 312 IAC 13-8-3 for additional information.

(V) WELL SCREEN

(A) "*A monitoring well screen shall be composed of materials that will not corrode or react with chemicals found in the ground water at the site.*" (312 IAC 13-8-3)

(B) "*The well screen slots shall not be hand cut and shall be sized to retain at least ninety percent (90%) of the grain size of the introduced filter pack...*" (312 IAC 13-8-3)

(C) The screen should conform to the casing material standards in Section IV.

(D) Screen lengths should be not less than two feet and not greater than ten feet. Shorter screens may be used in nested wells, or for sampling discrete zones. Nonstandard wells should be discussed with the OLQ program manager and geologist before installation.

(E) Screen placement should be based on the type(s) and phase(s) of contamination, and aquifer type.

(1) If light non-aqueous phase liquids (LNAPLs), are the contaminants of concern, then the well screen should be placed at the top of the aquifer.

(2) If dense non-aqueous phase liquids (DNAPLs) are the contaminants of concern, then nested wells should be installed, extending from the top of the aquifer to slightly below the base of the aquifer. If DNAPLs are suspected, great care needs to be taken not to breach confining layers, which could spread the contamination to a deeper aquifer.

(3) In an unconfined aquifer, and if the contaminants of concern are LNAPLs, the well screen should be set straddling the water table, with sufficient screen above the water table to allow for seasonal water table fluctuations to remain within the screened interval.

(4) If the aquifer is confined, the screen should be set to detect the type of contamination present. The presence of all reportedly confined aquifers should be verified by site data, which may include:

(a) An obvious and continuous, dry confining layer.

(b) Wells with screens set above the supposed confined aquifer that exhibit a definite head difference from the confined aquifer.

(c) A separate water bearing zone above the confined aquifer.

(5) Variations from the above recommendations should be supported by specific reasons from the consultant geologist for the project and should be discussed beforehand with OLQ.

Please refer to State Rule 312 IAC 13-8-3 for additional information on screen materials and slotting. Additional information on screen placement may be found in EPA/600/4-89/034.

(VI) FILTER PACK

(A) *"The introduced filter pack shall:(1) be properly sized and graded …"* (312 IAC 13-8-3), which OLQ interprets to mean that the filter pack should not allow silt and clay-sized sediments to clog the well screen.

(B) Filter pack material should consist of inert sand or gravel and comply with the following:

(1) A uniform grain size should be chosen which is three to five times the average fifty percent retained size of the formation material, unless this filter pack grain size would impede adequate flow of ground water into the well. Should this happen, a filter pack grain size should be used that allows ground water flow into the well and prevents as much silt infiltration as

possible.

(2)Natural, granular material, which will not clog the well screen, may be an acceptable constituent of the filter pack if slump is unavoidable.

(3)The upper one to two feet of the filter pack should be of fine, inert sand to prevent infiltration of seal materials.

(C) Pre-packed well screens may be used, if the packing material is sized correctly.

(D) The filter pack should be emplaced without bridging.

(E) The filter pack should extend at least one foot but "*not extend more than two feet above the top of the screen or the uppermost water bearing unit to be monitored…"*(312 IAC 13-8-3)

(F) For shallow monitoring wells with the screen less than three feet below the surface, it may not be possible to install a full-length filter pack or seal. If so, the filter pack should extend just above the screened interval, and the well should be grouted to the surface or surface seal.

(G) "*A monitoring well installed by the direct push method must be constructed as follows:*

(1) *The well shall be equipped with a pre-packed well screen.* (See subdivision C, above.)

(2) *A sand grout barrier shall:*

(a) *be placed directly above the pre-packed well screen in the annulus between the well casing (riser pipe) and the borehole wall as the probe rods are retracted;*

(b) *be installed to prevent bridging; and*

(c) *extend not more than two (2) feet above the top of the pre-packed well screen.*" (312 IAC 13-8-3)

Please refer to State Rule 312 IAC 13-8-3 for additional information.

(VII) FILTER PACK SEAL

(A) "*A filter pack seal of bentonite slurry or granular, pelletized, medium grade, or coarse grade crushed bentonite, may be placed in the annulus directly above the filter pack or sand grout barrier.*" (312 IAC 13-8-3)

(B) "*A filter pack seal may be installed under subsection* (A) *directly above the sand grout barrier*." (312 IAC 13-8-3)

(C) "*The filter pack seal shall:*

(1) *be installed to prevent bridging; and*

(2) *not extend more than two (2) feet above the filter pack or sand grout barrier*." (312 IAC 13-8-3)

(D) A bentonite filter pack seal should be hydrated with clean water if installed above the water table.

(VIII) WELL GROUTING MATERIALS

(A) "*Granular bentonite may be used to grout a monitoring well if the:*

(1) *diameter of the borehole is four (4) inches or larger than the nominal diameter of the well casing; and"*

(2) the "*well is no more than twenty-five (25) feet deep*

(B) *Except as provided in subdivision* [C], *the annulus of the monitoring well shall be pressure grouted with neat cement or a bentonite slurry or be grouted with pelletized, medium grade, or coarse grade crushed bentonite from the top of the filter pack or filter pack seal under* [Section VII] *(for a well installed in unconsolidated materials) or the bottom of the well casing (for a well penetrating bedrock) to the ground surface or to within one (1) foot of the ground surface if a flush mounted protective cover pipe is installed if the:*

(1) *diameter of the borehole is four (4) inches or larger than the nominal diameter of the well casing; and"*

(2) the "*well is not more than one hundred (100) feet deep.*

(C) *The annulus of the monitoring well shall be pressure grouted with neat cement or a bentonite slurry from the top of the filter pack or filter pack seal under* [Section VII] *(for a well installed in unconsolidated materials) or the bottom of the well casing (for a well penetrating bedrock) to the ground surface or to within one (1) foot of the ground surface if a flush-mounted protective cover pipe is installed where either the:*

(1) *diameter of the borehole is less than four (4) inches larger in diameter than the nominal diameter of the well casing; or"*

(2) the " *well is more than one hundred (100) feet deep*." (312 IAC 13-8-3)

(D) For a monitoring well installed by the direct push method, "*The remaining annulus between the well casing (riser pipe) and probe rods shall be pressure grouted with neat cement or a bentonite slurry from the top of the sand grout barrier or filter pack seal to:*
(1) *if a flush-mounted protective pipe is installed, within one (1) foot of the ground surface; or*
(2) *the ground surface*." (312 IAC 13-8-3)

(E) For a monitoring well installed by the direct push method, "*The probe rods shall be pulled during installation of the grout material."* (312 IAC 13-8-3)

(F) Well cuttings should not be used for grout. "*Grouting materials shall consist of:*
(1) *neat cement with no more than five percent (5%) by weight of bentonite additive;*
(2) *bentonite slurry (which can include polymers designed to retard swelling);*
(3) *pelletized, granular, medium grade crushed, or coarse grade crushed bentonite*." (312 IAC 13-5-1)

If someone wishes to use other grouting materials, contact OLQ or check the Rules cited above.

(IX) WELL GROUTING

(A) "*This section applies if neat cement or a bentonite slurry is used for grouting. The cement or slurry shall be pumped into place from the bottom of the annular space upward in a continuous operation with a grout pipe or the well casing using the positive displacement method.*

(B) *Grouting material, other than neat cement or bentonite slurry, shall be introduced in a manner to prevent bridging of the annulus between the outside of the well casing and the borehole.*

(C) *A borehole annulus shall be grouted upon the earlier of the following:*
(1) Within twenty-four (24) hours after the installation of the well casing.
(2) Before drilling equipment is removed from the site." (312 IAC 13-5-1)

(X) FINISHED WELL CASING

(A) Monitoring well casing that extends above the ground surface should be installed as follows:
(1) Except in areas where the well may be susceptible to damage, "*the finished well casing*
(a) *shall extend at least two (2) feet above the ground level and*
(b) *if located in a flood plain, must be:*
(i) at *least two (2) feet above the elevation of the regulatory flood or*
(ii) *equipped with a watertight cap.*
The monitoring well shall be located to protect against surface water ponding, and earthen materials, neat cement, or concrete shall be placed around the well casing to drain surface water from [around] *the well*." (312 IAC 13-8-3)
(2) "*A monitoring well, located where the casing is susceptible to damage, shall be equipped with a protective outer pipe consisting of a metal casing having a diameter large enough to allow easy access to the well. The protective cover shall be firmly anchored in the ground. Additional protective devices, for example, brightly colored posts around the well, are required where construction equipment or vehicular traffic could damage the well.*" (312 IAC 13-8-3)
(3) "*A monitoring well must be equipped with a locking cap or cover to prevent unauthorized access. The locking cap may be placed:*
(a) *directly on the well casing, or*
(b) *if required under subsection* [A1, above], *on the protective cover pipe*." (312 IAC 13-8-3)

(B) "*A monitoring well installed so that the top of the well casing is finished at an elevation below the ground surface shall be equipped with a watertight cap. The top of the well casing shall terminate at a depth no greater than one (1) foot below the ground surface and shall be located in a flush-mounted protective cover pipe. The flush mounted protective cover pipe shall include each of the following:*

(1)*A watertight one (1) piece or continuous welded metal casing:*
(a) *at least one (1) foot long; and*
(b) *having a nominal diameter at least four (4) inches greater than the nominal diameter of the monitoring well.*
The casing shall be flanged for greater stability if installed in a location likely to be subject to vehicular traffic.
(2) *A concrete ground surface seal, if an impervious surface, for example, concrete or asphalt, is not present. The ground surface seal shall be installed and extend not more than three (3) feet below the ground surface.*
(3) A sealed lid that is no more than one-half (½) inch higher than the elevation of the *ground surface. The sealed lid shall be as follows:*
(a) Of a quality to withstand vehicular traffic if installed in a location likely to be subject *to vehicular traffic.*
(b) Clearly marked with the words "MONITORING WELL" or "MONITOR" and also *display the words "DO NOT FILL"*." (312 IAC 13-8-3)
(C) A monitoring well installed so that the top of the well casing is finished at an elevation below the ground surface should be locked as in Section X (A) (3), above.

(XI) WELL DEVELOPMENT

(A) "*A monitoring well shall be developed following installation and before water samples are collected. This development shall be accomplished to produce water that is as free as practicable from the following:*
(1) *Sediment.*
(2) *Drill cuttings*
(3) *Drilling fluids.*
(B) *If a well is installed to monitor ground water quality, the well shall be adequately developed to produce a representative sample of the water quality*." (312 IAC 13-8-3)
(C) Wells should be developed at least twenty-four hours before sampling takes place.
(D) Well development should be confirmed by taking measurements of turbidity, until readings stabilize.

(XII) DRILLING FLUIDS, CUTTINGS, AND DEVELOPMENT WATER

"*Contaminated drill cuttings, fluids, and surge and wash waters produced in the drilling and development of a monitoring well shall be collected and contained to:*
(A) *prevent contamination of the area; and*
(B) *protect persons who might otherwise come in contact with these materials.*" (312 IAC 13-8-3)

OLQ interprets these requirements to include water produced during well or aquifer tests, and purge water for sampling. Sample and properly dispose of all known or suspected contaminated material, according to applicable rules (IC 13-30-2-1).

(XIII) DECONTAMINATION

"*Monitoring well construction and development equipment that comes in contact with contaminated water or contaminated geologic materials shall be cleaned with high pressure hot water or steam, using inorganic soap or other suitable solvents, and rinsed thoroughly. Contaminated fluids or wash waters shall be collected and contained so that the result is not contamination of the area or a hazard to individuals who may come in contact with these materials*." (312 IAC 13-8-3)

OLQ interprets this to mean that all materials known or suspected to be contaminated must be sampled and properly disposed. (IC 13-30-2-1)

(XIV) USE OF LICENSED WATER WELL DRILLER

All monitoring wells shall be installed by an Indiana licensed water well driller as required by IC 25-39-3. This includes borings encountering groundwater, installed by any method. The name and license number of the driller should be included on all boring and well logs.

Please refer to State Rule 312 IAC 13-3 and Indiana Code IC 25-39-3 for additional information.

(XV) INFORMATION NEEDED FOR OLQ REMEDIATION BRANCH PROJECTS

(A) All information should be typed. Illegible logs are not acceptable.
(B) Diagrammatical borehole drilling logs should be of similar scale and include the following information:
- (1) The borehole identification label.
- (2) The date of drilling or installation.
- (3) The method of drilling.
- (4) The name and license number of the driller and (if applicable) the geologist.
- (5) The borehole diameter.
- (6) The method of sampling consolidated material and unconsolidated material.
- (7) The type of drill fluids, fluid additives, or lubricants other than water, that have been used.
- (8) Penetration measurements (if available), such as hammer blow counts, penetrometer measurements, or other acceptable penetration measurements.
- (9) The sample recovery measured to the nearest one-tenth (.10) foot.
- (10) Consolidated material and unconsolidated material field descriptions, including the following information:
  - (a) Lithology and sedimentology.
  - (b) Minerology.
  - (c) Degree of moisture.
  - (d) Evidence of contamination, such as field screening, odors or staining,
  - (e) Color as referenced from soil color charts such as the Munsell soil charts.
  - (f) Grain size and textural classification of unconsolidated samples as referenced from the United States Department of Agriculture or Unified textural classification charts. Consolidated samples should be described using accepted geological classification systems and nomenclature. The classification systems used should be noted on the logs.
  - (g) Any other physical characteristics of the consolidated material and unconsolidated material such as fracturing, solution features, anthropogenic materials, or pedologic characteristics.
- (11) Distance to, and depth of, water bearing zones, measured to the nearest one-hundredth (0.01) foot.
- (12) Location information sufficient to permit the boring or well to be found on site. Acceptable methods include a scaled map, UTM coordinates, state plane coordinates, etc.
- (13) Location (depth) of all samples collected.

(C) Diagrammatical construction and design diagrams of all ground water monitoring wells should also include the following information:
- (1) The composition of well and protective casing materials.
- (2)The type of joints and couplings between well casing segments.
- (3)The elevations of the top of the well casing and the ground surface, surveyed to the nearest one-hundredth (0.01) foot, and referenced to mean sea level.
- (4) The diameter of well casing and borehole.
- (5) The elevation of the bottom of the borehole and the depth of the borehole.
- (6) The screen slot size and type.
- (7) The depth and elevation range of the screened interval.
- (8) The screen length, measured to the nearest foot.
- (9) Methods of installation of the annular fill.
- (10) The elevation range and the depth of the filter pack.
- (11) The grain size and composition of all filter pack materials and the fifty- percent (50%) retained size of the formation material used to determine filter pack materials.
- (12) The elevation and depth range of the bentonite seal above the filter pack.
- (13) The composition of annular fill.
- (14) The elevation range, depth range, and thickness of annular fill.

(15) The composition and design of the surface seal.
(16) The design and composition of materials used for the protection of the well casing.

Please refer to State Rule 329 IAC 9-5-5.1 for additional information

Please note that a report, containing IDNR-specific reporting requirements, must be sent to IDNR for each well installed, per 312 IAC 13-2-6.

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Part 2. ABANDONMENT OF BORINGS AND MONITORING WELLS

(I) TIMEFRAME

(A) "*A well that is drilled after December 31, 1987, and not equipped with casing* [i.e. an open borehole] *must be plugged by the driller within seventy-two (72) hours after drilling is completed*." (IC 25-39-4)

(B) Wells can either be temporarily or permanently abandoned. Any monitoring well that has not been used or maintained for a period of five years should be permanently abandoned in accordance with Part 2. III, Permanent Abandonment.

Please refer to State Rule 312 IAC 13-10-2 and Code IC 25-39-4 for additional information.

(II) TEMPORARY ABANDONMENT

"*A well which has not been used for more than three (3) months without being permanently abandoned must be sealed at or above the ground surface by a welded, threaded or mechanically attached watertight cap. The well shall be maintained so that it does not become a source or channel of groundwater contamination*." (312 IAC 13-10-1)

(III) PERMANENT ABANDONMENT

Boreholes and wells "*shall be plugged with an impervious grouting material to prevent the migration of materials or fluids in the well and the loss of pressure in a confined aquifer*." (312 IAC 13-10-2) This means that the well screen and casing are completely filled with impervious grouting material.

Upon abandonment of any borehole or monitoring well, a written notice of permanent abandonment, referencing the abandonment date, boring or well identification, and location, should be provided to the OLQ program manager, and is required to be provided to DNR, within thirty days after plugging is completed. (IC 25-39-4)

Borehole and well abandonment must be performed by an Indiana licensed well driller. (IC 25-39-4)

Please refer to State Rule 312 IAC 13-10-2 and State Code IC 25-39-4 for additional information.

(IV) PLUGGING PROCEDURES

(A) "*A cased or uncased monitoring well shall be plugged from the bottom of the well or borehole to the ground surface with a:*
(1) bentonite slurry; or
(2) pelletized or coarse grade crushed bentonite." (312 IAC 13-10-2)

(B) "*… bentonite slurries shall be pumped into place in a continuous operation with a grout pipe introducing the plugging material at the bottom of the* [boring or] *well and moving the pipe progressively upward as the well is filled*." (312 IAC 13-10-2) Contain displaced water and

properly dispose in the same manner as Part 1, Section XIII.

(C) *"Plugging materials other than… bentonite slurry shall be installed in a manner to prevent bridging of the well or borehole. The well or borehole shall be measured periodically throughout the plugging process to ensure that bridging does not occur*." (312 IAC 13-10-2)

Part 3. GLOSSARY

"Abandon" is to terminate operations of a well for water supply, monitoring, dewatering, or geothermal purposes and restore the site of the well in a manner that will protect ground water resources from contamination. (312 IAC 13-1-2)

"Bentonite" is clay material composed predominantly of sodium montmorillonite that meets American Petroleum Institute specifications standard 13-A (1985). (312 IAC 13-1-4)

"Bentonite slurry" is a mixture, made according to manufacturer specifications, of water and commercial grouting or plugging bentonite that contains high concentrations of solids. The term does not include sodium bentonite products that contain low solid concentration or are designed for drilling fluid purposes. (312 IAC 13-1-5)

"Bridge" is a barrier created by any unwanted object or material that prevents the introduction of grouting materials in the borehole or well. (312 IAC 13-1-6)

"Coarse grade crushed bentonite" is natural bentonite crushed to an average size range of three-eighths (3/8) to three-fourths (3/4) inches. (312 IAC 13-1-7)

"Confined aquifer" is an aquifer that contains sufficient hydrostatic head to cause ground water to rise above the upper boundary of the aquifer. (312 IAC 13-1-9)

"Contamination" is the degradation of natural water quality as a result of human activities. (312 IAC 13-1-10)

"Direct-Push" is a type of drilling where the drill rig uses direct pressure to push a tool instead of augers or a cable tool.

"Grab Sample" is a discrete one–time only sample taken from a borehole.

"Grout" is fluid material (composition defined in Part One, Section VIII) poured or injected into a borehole, well, or annular space between the well casing and the borehole, to form an impermeable seal.

"Grout pipe" is a length of hose or pipe positioned in the annular space of a well, between the well casing and the borehole, used for the introduction of grouting materials. (312 IAC 13-1-15) Also known as a tremie pipe.

"Medium grade crushed bentonite" is natural bentonite crushed to an average size range of one-fourth (1/4) to three-eighths (3/8) inch. (312 IAC 13-1-17)

"Monitoring well" is a well installed to obtain hydrogeological information or to monitor the quality or quantity of ground water. (312 IAC 13-1-18)

"Neat cement" is a mixture of ninety-four (94) pounds of cement and no more than six (6) gallons of clean water. Additives designed to increase fluidity may not exceed 5 percent (5%) of the total. (IC 25-39-2-13)

"Piezometer" is a type of monitoring well used only to measure groundwater levels, and not for sampling to monitor groundwater quality.

"Thermoplastic pipe" is plastic pipe made of acrylonitrile butadiene styrene, polyvinyl chloride or rubber-modified polystyrene with standards listed in American Society of Testing and Materials. (312 IAC 13-1-23)

"Unconsolidated formation" is geologic material or deposits overlying bedrock, such as sand, gravel and clay. (312 IAC 13-1-24)